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Journal of the Society of Arts.

FRIDAY, APRIL 16, 1858.

EXHIBITION IN 1861.

At a Special Meeting of the Council, held on Wednesday last, the 14th inst., the following resolutions were passed:—

The Council of the Society of Arts, bearing in mind the part which the Society took in originating the Great Exhibition of 1851, have considered it to be their duty carefully to examine various suggestions for holding an Exhibition in 1861, which have been submitted to them, and have resolved:—

1. That the institution of Decennial Exhibitions in London, for the purpose of showing the progress made in Industry and Art during each period of ten years, would tend greatly to the "Encouragement of Arts, Manufactures, and Commerce."

2. That the first of these exhibitions ought not to be a repetition of the Exhibition of 1851, which must be considered an exceptional event, but should be an Exhibition of works selected for excellence, illustrating especially the progress of Industry and Art, and arranged according to classes, and not countries; and that it should comprehend Music and also Painting, which was excluded in 1851.

3. That Foreigners should be invited to exhibit on the same conditions as British Exhibitors.

4. That the Council will proceed to consider how the foregoing resolutions can be best carried into effect.

CONVERSAZIONI.

The Council have arranged for two *Conversazioni* during the present session; the first on Saturday, the 24th April, at the Society's House, the card for which will admit the member only; the second on Saturday, the 8th May, at the South Kensington Museum, the card for which will admit the member and two friends, ladies or gentlemen. The cards for each of these evenings have been issued. Members who have not received them are requested to communicate with the Secretary of the Society of Arts.

Members of Institutions in Union who are anxious to attend either of these *Conversazioni*, are requested to apply to the Secretary of the Society of Arts, through the Secretary of the Institution to which they belong.

TENTH ANNUAL EXHIBITION OF INVENTIONS.

The Exhibition was opened on Monday, the 5th instant.

The Exhibition will remain open every day until further notice, from 10 a.m. to 4 p.m., and is free to members and their friends. Members, by ticket, or written order bearing their signa-

ture, may admit any number of persons. The number of visitors up to yesterday, the 15th inst., was 1,785.

LOCAL BOARDS—PREVIOUS EXAMINATION.

Fifty Local Boards have been formed. Returns of the Candidates who have passed the Previous Examination have been received up to the 15th inst., as follows:—

Louth	4
Wigan	6
West Hartlepool.....	3
Leeds (Christian Institute). No. 1.	14
Northowram	1
Portsmouth	2
Warminster.....	1
Banbury	2
Macclesfield.....	83
Newcastle-on-Tyne	3
Lymington	1
West Brompton	4
Leeds, No. 2.....	10
Wakefield	4
Pembroke Dock	4
Ipswich	6
London Mechanics' Institution.....	8
Manchester Mechanics' Institution	32
Selby	9
Bradford	17
Halifax	15

Institutions and Local Boards are requested to take notice, that the Returns of the Previous Examinations should be forwarded *immediately* to the Secretary of the Society of Arts.

EXAMINATION PRIZE FUND FOR 1858.

The following is a list of Donations up to the present date:—

T. D. Acland, Member of Council.....	£	5	5
The Rt. Hon. C. B. Adderley, M.P.		5	0
John Ames.....		5	5
J. G. Appold, F.R.S., Auditor		10	10
T. H. Bastard		5	0
Messrs. Chance, Brothers.....		10	10
R. L. Chance		5	5
Harry Chester, Vice-Pres.		10	10
J. P. Clarke		1	1
G. Clowes		10	10
Henry Cole, C.B., Vice-Pres.		1	0
H. D. Cunningham, R.N.		1	1
C. Wentworth Dilke, Vice-Pres. Chairman of Council (third donation)		10	10
Thomas Dixon		1	1
Lieut.-Col. F. Eardley Wilmot, R.A.		5	0
Lord Ebury		5	0
J. Griffith Frith, Member of Council		5	5
J. W. Gilbert, F.R.S., Treasurer (second donation).....		10	10
F. Seymour Haden (annual)		2	2
William Hawksworth		1	1
Edward Highton (annual)	£	2	2
James Holmes (annual)		1	1
The Marquis of Lansdowne, Vice-Pres.....		20	0
George Lowe, F.R.S.		1	1
The Master of the Mint, Member of Coun- cil (second donation).....		10	10

George Moffatt, M.P.	£10	10
Sir Thomas Phillips, Member of Council ...	5	5
William T. Radford.....	1	1
Charles Ratcliff, Hon. Local Sec. (annual)...	10	10
Joseph Skey, M.D.	1	0
William Tooke, F.R.S., Vice-Pres.....	10	10
Arthur Trevelyan	1	0
T. Twining, jun., Vice-Pres.	10	10
Dr. J. Forbes Watson	1	1
G. F. Wilson, F.R.S., Member of Council } (third donation).....	10	10

GUTTA PERCHA.

The Council have appointed a Committee to direct the institution of a series of experiments on Gutta Percha, and to report from time to time such observations as may appear to elucidate the nature and cause of its decay, the different qualities of the substance, modes of detecting adulteration, or any other points valuable to the manufacturer or to those who use it.

The Council invite the co-operation of the Agricultural Societies in the superintendence of a series of experiments, especially as regards the employment of Gutta Percha in different soils, and for the distribution of liquid manures.

The Committee consists of the following, with power to add to their number :—

*H. Ford Barclay.

The Rev. M. J. Berkeley, M.A., F.L.S.

Dr. Albert J. Bernays, F.C.S., Lecturer on Chemistry, St. Mary's Hospital, London.

*Dugald Campbell, F.C.S.

Latimer Clark, A. Inst. C.E., Engineer to the Electric Telegraph Company.

Arthur Henfrey, F.R.S., Professor of Botany, King's College, London.

*Edward Highton, A. Inst. C.E., F.H.S., Consulting Engineer to the British and Irish Magnetic Telegraph Company.

John Lindley, F.R.S., Professor of Botany, University College, London.

*C. W. Siemens, C.E.

*Professor E. Solly, F.R.S. (Mem. of Council.)

*Sir Walter C. Trevelyan, Bart.

* Members of the Society of Arts.

The Committee have met three times, and with the view of obtaining as much information as possible in reference to the subjects above referred to, they propose to issue the following questions, which will be circulated amongst those most likely to afford the desired information :—

1. Over how long a period does your experience of the use of Gutta Percha extend, and for what purpose was the Gutta Percha employed?

2. Have you found the Gutta Percha so used to change its character, or decay, after a certain period? If so, state the length of this period, and the nature of the change.

3. Have you had the Gutta Percha analysed before and after this change? If so, give the analyses.

4. Can you state what change takes place in Gutta

Percha during its apparent drying and contraction, when exposed to the weather?

5. What, in your opinion, is the most effectual method of arresting this change?

6. Have you met with Gutta Percha mixed with any other substance, and, if so, with what substance or substances, and what have been the effects?

7. Have you had any experience of sulphured Gutta Percha, and, if so, state the results?

8. Have you made any experiments as to the tenacity of Gutta Percha? If so, what were the results; and were your experiments made with fresh or old Gutta Percha?

9. Have you found that exposure to light, heat, damp, cold, or any other special influences, alters the character of Gutta Percha?

10. Have you found any substance, such as tar, sea water, common water, &c., to be preservative of Gutta Percha?

11. Have you found that any particular substances have an injurious effect on Gutta Percha, or have you noticed that any insects or animals attack it?

12. Can you suggest any method of joining Gutta Percha superior to that now employed?

13. Do you know any means of rendering Gutta Percha a more perfect non-conductor of electricity?

The Committee are also desirous of obtaining information on the following points, having reference to the sources of supply of Gutta Percha :—

14. Is the Gutta Percha taken from the trees at particular seasons exclusively?

15. If taken at one particular season, does that correspond to the time of the renewal of foliage, of blossoming, or of ripening seed?

16. If taken at different seasons, at which of these seasons is the best quality obtained?

17. Has the age of the tree any influence on the quality of the Gutta Percha?

18. Is there any method practised of procuring Gutta Percha from a tree without cutting it down, and if so, with what results?

19. Are the products of different species of plants known indiscriminately under the name of Gutta Percha?

20. How far do the different qualities of commercial Gutta Percha depend upon any of the last six questions?

21. If Gutta Percha is produced by several trees, what are the scientific or native names of those trees, and which of them is at once productive of the best quality and most calculated for cultivation?

22. What parts of the world, and what kinds of soil and climate, appear to be best adapted for the cultivation of trees producing Gutta Percha?

23. What is the best mode of cultivation, whether by seed, cuttings, &c.?

24. What measures might be adopted with advantage to secure a continual and increasing supply of Gutta Percha?

25. If you have no experience yourself in this subject, do you know of any person who has, and who, by answering the above questions, or some of them, might tend to advance the present inquiry?

The Committee would feel obliged by replies to any of the above questions, as well as suggestions of experiments likely to elucidate the subject, being addressed to the Secretary of the Society of Arts, Adelphi, London, W.C.†

† Any person having portions of decayed or altered Gutta Percha, the causes of the change in which he is able to state, is invited to forward them to the Secretary of the Society of Arts, with their history.

As the labours of the Committee will be considerable, in arranging and tabulating the results of this enquiry, it is particularly requested that answers to any of these questions be written only on one side of the paper, and that the number of the question answered be given at the head of each reply.

EIGHTEENTH ORDINARY MEETING.

WEDNESDAY, APRIL 14, 1858.

The Eighteenth Ordinary Meeting of the One Hundred and Fourth Session was held on Wednesday, the 14th inst., J. Scott Russell, Esq., F.R.S., Vice-President, in the chair.

The following Candidates were balloted for and duly elected members of the Society:—

Adderley, the Right Hon.	Bowles, Richard Francis
Charles Bowyer, M.P.	Oxley, John
Shuttleworth, Sir James Kay, Bart.	

The following Institution has been taken into Union since the last announcement:—

Wycombe Literary Institute.

The Paper read was—

ON THE PADDLE-WHEEL AND SCREW-PROPELLER, FROM THE EARLIEST TIMES.

By JOHN MACGREGOR.

The approaching trial, for the first time, and on the grandest scale, of the paddle-wheel and screw-propeller in the same vessel, may well suggest the consideration of these two instruments in the same paper, while they are so different in origin and operation, that it will be best to treat of each of them separately.*

We shall begin with the paddle-wheel as the older method, though the other was first matured, and is now the more popular.

Several modern writers state that the paddle-wheel was used by the ancient Egyptians, but I can find no proper evidence to warrant this assertion.

The wheel of a chariot in an old Egyptian painting of a boat, has often been mistaken for a paddle-wheel, and a precisely similar mistake has been made in describing one of the sculptured slabs from Nineveh, but Sir H. Rawlinson and Dr. Layard assure me, that in their Babylonian researches they have not discovered any indication of the use of machinery for propelling vessels.†

Pancirollus, who wrote in 1587, says he saw an old bas-relief representing an Illyrian galley propelled by three wheels on each side turned by oxen. The same author, and several others, refer to Vitruvius for a notice of the paddle-wheel, but I find, in five editions of Vitruvius, the drawings represent merely a wheel turned by the water, and used as a log to measure the speed.

Again, Claudius Codex is said to have employed paddle-wheels in the invasion of Sicily in the third century before Christ, and some MSS. in the King of France's library (which I have not been able as yet to inspect), are referred to for this statement, but after diligent inquiry, I can find no confirmation of it in any accredited authority. An old work on China contains a sketch of a vessel moved by four paddle-wheels, and used perhaps in the seventh century, but the earliest distinct notice of this means of propulsion appears to be by Robertus Valturius, in A.D. 1472, who gives several woodcuts representing paddle-wheels.

Some months ago, I inspected two letters, written in A.D. 1543, by Blaseo de Garay, and now preserved in the national archives at Simancas, in Spain. These give the particulars of experiments at Malaga and Barcelona, with large vessels propelled by paddle-wheels, turned by 40 men. By many authors, and for a long time, it has

been positively affirmed that Blaseo de Garay used a steam-engine for marine propulsion, but, after careful and minute investigations at Simancas, Madrid, and Barcelona, I cannot find one particle of reliable evidence for this assertion.

After the various notices referred to, we find boats propelled by paddle-wheels mentioned by many early writers, such as Julius Scaliger, in 1558, Bourne in 1578, Ramelli in 1588, and Roger Bacon, 1597.

Before we consider the application of the steam-engine to turn paddle-wheels, it is well to notice briefly some of the other agencies employed.

The muscular power of men, of horses, and of other animals, was often used and frequently patented, even to the year 1848, by Miller; and 1856, by Moses. The Marquis of Worcester, in 1661, patented the application of a current, to turn paddlewheels on a vessel which they propelled by winding up a rope.* Papin, in 1690, proposed to work the wheels by gunpowder, exploded under pistons; Conrad (1709) used the force of the wind, Maillard (1733) and Goutart (1853) applied clockwork, Harriott (1797) used falling water; weights were employed by Tremere (1801); Congreve (1827) used the capillary attraction of a wheel of sponge or glass plates; Dundonald (1833) applied the oscillations of mercury, and Jacobi (1838) employed an electro-magnet to work the paddle-wheels of a vessel on the Neva. The whole number of English patents relating to marine propulsion is 802, from the earliest, granted to Ramsey in 1618, to those of June, 1857.†

It appears that Denis Papin, in 1690, first proposed to use steam to work paddle-wheels. A rackwork was moved by pistons descending in steam cylinders by atmospheric pressure. Savery, in 1702, scarcely ventured with timidity to suggest the use of his steam-engine for the purpose, but it is asserted in a French work that Papin, in 1707, actually propelled a vessel on the Fulda by Savery's engine.

The first patent relating to a steam-boat is that of Jonathan Hulls, in 1736. He placed a paddle-wheel on beams projecting over the stern, and it was turned by an atmospheric steam-engine, acting in conjunction with a counterpoise weight, upon a system of ropes and grooved wheels.

The Comte d'Auxiron and M. Perrier are stated to have used a paddle-wheel steamboat in 1774, but the notices of these and of other early experiments are very vague, not contemporaneous, or on doubtful au-

* Chabert (1710), Drouet (1722), Pitot (1729), and Boulogne (1729), used a similar plan.

† The information contained in this paper was collected by the writer in compiling, for the Great Seal Patent Office, the "Abridgements of the Specifications" of these patents. Parts I. and II. of this work have been published by the Commissioners of Patents, and the remaining Part will shortly appear. As the authority for every statement is distinctly given in these publications, it will not be necessary to give references here. The following statistics relate to the patents above-mentioned. Patentees resident in the city of London, 83, in the county of Middlesex and city of Westminster, 252; Surrey, 59; Lancashire 46; Kent, 29; Hants 19; Yorkshire, 18; Gloucester, 18; Essex, 11; Sussex, 10; Northumberland, 9; Chester, 9; Worcester 6; Stafford 6; Derby, 5; Nottingham, 5; Durham 5. All the other counties have a less number and ten of them have only one each. Patentees resident in Scotland, 45; Ireland, 20; America, 18; other foreign states 46. Patents "communicated from abroad" 64; with two or more patentees 66. The patentees are described by the following avocations—engineers, 273; gentlemen, 251; tradesmen, 74; naval commanders, 14; medical, 11; ship-builders, 11; peers, 8; shipowners, 8; mariners, 5; machinists, 5; farmers, 4; architects, 4. A less number to each of 21 other professions. There are two female patentees, and the callings of 160 are not mentioned. 80 of the patents are dated in January, 46 in August, and the other months have intermediate numbers. 305 of these patents are under the new law since 1852, and of these 110 were allowed to become void after 6 months.

* The paddle-wheel propels a vessel in a direction perpendicular to the shaft, while the screw-propeller urges it in a direction parallel to the shaft.

† An old Chinese woodcut, in the late Dr. Morrison's library (at University College Library), has some resemblance to a paddle-wheel, but this also is probably misinterpreted.

thority. Desblancs, in 1782, sent a model to the Conservatoire (still there) of a vessel in which an endless chain of floats is turned by a horizontal steam-engine.

The first notice I can find of a successful trial of the steam-boat recorded by witnesses, is in a notarial certificate, which I lately inspected in Paris. This asserts that in July, 1783, the Comte de Jouffroy caused a vessel of 130 feet in length to be propelled for a quarter of an hour by a steam-engine upon the Saône, near Lyons.*

Experiments conducted about the same time, at Dalswinton, in Scotland, by Patrick Miller, resulted, in 1787, in the successful use of a steam-engine, by Miller, Taylor, and Symington, to propel a vessel by paddle-wheels, which worked one before the other in the centre of the boat.

The engine of this, the first practical steam-vessel, is still preserved by Mr. Bennet Woodcroft, Superintendent of Specifications at the Great Seal Patent Office, and it may now be seen at the Patent Museum in Kensington.

The *Charlotte Dundas* was built on the Clyde canal in 1801. Although Fulton used a steamer on the Seine in 1803, and another in America, *The Clermont*, in 1807, was the first that plied so as to be remunerative in that country. In 1809, the *Fulton* the first, steam-frigate, was launched at New York. Bell built the *Comet* in 1811, at Glasgow, and used it regularly for traffic next year. In 1815, Dr. Dodd steamed from Glasgow by Dublin to London in the *Thames*, which made a stormy passage of 758 nautical miles in 121 hours.

Steam navigation was introduced into France in 1815. In 1818, Napier's steam-packets ran regularly between Greenock and Belfast. It is said that, in 1819, the *Savannah* steamed from New York to Liverpool, but the assertion is very questionable. The *Comet* first carried the Admiralty pennant in 1822. In 1825, the *Enterprise* steamed from England to Calcutta in 113 days. Guns were first carried by the steamer *Salamander* in 1832.†

With respect to the various positions of paddle-wheels, it will be observed that most of those in earliest use were placed at each end of a shaft across the vessel. In Hull's plan (1736) the wheel was behind the stern; Bramah (1785), Miller (1787), and Symington (1801), placed the wheels in a passage inside the vessel open to the water. In Phillip's plan (1821) a wheel on deck turned on a vertical axis, and each float folded up to pass over the vessel. Submerged wheels on vertical axes were frequently patented. Sharples (1821) worked his wheel against the air; Harsleben (1826) placed the paddle-shaft at an angle to the horizon; Robertson (1829) and Perkins (1829) kept it horizontal, but inclined to the line of the keel, and the floats being turned at an angle in the opposite direction, entered the water in the usual way. Sharpley (1856) substituted for the wheel and floats a drum carrying a spiral rib; ‡ Belford (1853) put the engine and cargo inside a hollow drum, with floats outside, that propelled it as the drum revolved.

Having thus noticed the paddle-wheel generally, as to when it was introduced, how it was turned, and where it was placed, we may proceed to consider various plans and inventions relating to its several parts, but it is to

be distinctly understood that I refrain from comparing the relative merits of these different suggestions.

Beginning, then, with the shaft and wheel, as a whole, we find that Tremeere (1801) and Robinson (1826) supported it on a stage, to be raised and lowered by ropes. For the same purpose Melville (1845) used a cogged sector, and Drake (1851) employed screws; * Coles (1839) supported the shaft on friction wheels.

To enable the engineer to use only one wheel at a time, Gough (1828) put each on the shaft of a separate engine, while in Field's plan (1841) the wheel was disconnected by moving it and the part shaft horizontally. For the same purpose Wilkinson (1835) moved a sliding crank plate along the divided shaft, until the crank-pin locked into it. Brunet (1843) used a sliding ring and bolts; Thomas (1851) employed wedges and a friction cushion. In Seaward's plan (1840) the parts were coupled by friction surfaces, screwed up to close contact. Trewhitt (1840) tightened a friction strap by cutters; Bodmer (1843) and Borrie (1843) used cogwheels; Scott Russell's patent (1853) gearing worked by the motion of the shaft is applied to the *Leviathan*. Price (1823) used intermediate wheels to regulate the relative speed of the engine-shaft and paddle-shaft. The groove and stud apparatus of Parlour (1838) gave the wheel twice the speed of the engine-shaft.†

The modifications of the wheel itself are difficult to classify. Barton (1820), Sang (1852), Belford (1853), and many others, made it a buoyant drum; Stevens (1827) put floats on three arms, not in the same plane. Springs were introduced by Adams (1839 and 1855) to ease concussion. Skene (1827) had side plates on the rims. In Tayler's plan (1840) one wheel might be covered from the water by a shield. Essex (1838), by dividing the wheel horizontally, folded back one part by hinges on the rim; while in Drake's plan (1851) the arms fold on hinges, like a fan. Galloway (1832) and Herbert (1855) attached an additional wheel, by a short shaft jointed to the outer end of the other, so that the rims of the wheels approached under water, and were more apart at the upper edges. Daubeny (1840) made the second outside wheel turn slower than the inner one, but in a parallel plane.

Let us next turn attention to the floats or paddle-boards, and first as to those that are immovable on the wheel. Floats of the simple rectangular radial form were the earliest in use. Pitot (1729) put floats in planes tangential to the surface of a cylinder on the shaft; Perkins (1829) placed them at an angle to the shaft; Sharpley (1856) aggregated them into one continuous spiral rib; Galloway (1832) used two sets of floats, inclined in different directions; Chatterton (1842) and Stevens (1851) inclined each float in an opposite direction to the next, which projected beyond it at one end. Brooman (1852) put the oblique floats with one end further from the shaft than the other; Carter (1832) put a valve between each pair of inclined floats. This was to let out the backwater, which was effected in Pickworth's plan (1836), by louvre boards in the float, in Elvey's (1837) by a valve, and in Woodley's (1839) by holes bored diagonally through the float. Galloway (1835) divided the float horizontally, and put the parts successively in advance of each other. In Gemmel's plan (1837) the middle part was foremost, and Jones (1847) made the parts to overlap.

The edges of floats were curved by Robertson (1829). Ruthven (1830) made them of a barrel shape,‡ and there

* No description of the machinery of this vessel is given before that published, in 1816, by the Marquis de Jouffroy, who gives a sketch of the steam-boat. A copy of this is in the Great Seal Patent Office Library.

† The Emperor of Japan received a steam yacht, as a present from the Queen of England in 1858. The Chinese now use mock steam-boats, with paddles turned by men concealed inside.

‡ Both these last two methods tend to propel the vessel in a line inclined to the shaft, and, in this respect, their operation is intermediate between those of the paddle-wheel and screw-propeller.

* The connecting-rod had a screw joint, which allowed its length to accommodate itself to the varied distances between the piston-rod and the shaft.

† Murdoch (1839), Brown (1842), and Bodmer (1844), had plans somewhat similar.

‡ Hollow floats were used by Berry (1831), to condense the steam conducted through the arms.

is scarcely any other form which has not been proposed for them at one time or another.*

Floats were made moveable, for reefing, shipping, and feathering. For reefing, Parr (1825) made the floats slide on the arms with joints. Galloway (1843) placed the moveable pieces on a separate inside wheel, moving laterally on a hollow shaft, and Brunet (1843) placed them on different sides of the arm.†

Hall (1839) and Bird (1842) protruded them by a fixed spiral groove. They might be folded on hinges in Tremere's plan (1801), and were worked through screw rods by Holebrook (1838). In Leeming's plan (1835) and Newton's (1843), each float protruded during part of every revolution. Redmund (1838) made them fall back by hinges as they revolved. Each float ran out and in by its buoyancy in Oxley's plan (1845).

The contrivances for feathering floats are numerous. In some cases, each float turns like an oar on a spindle, radial from the shaft, as in Duquet's plan, in 1693, where they feathered by fixed tappets. This was frequently patented afterwards. Two sets of such floats were used by Oldham (1820); Stead (1828) turned them by grooved guides, and Symington (1834) by cog-wheels. But the more common method was to cause the float to feather on a horizontal axis, parallel with the shaft. Silvester (1792) effected this by a spindle turned by a fixed cog-wheel; Broomfield (1825) made the principal cog-wheel adjustable by a screw; Steenstrup (1827) and Brown (1845) used an endless chain to regulate the angles of the float; Holebrook (1832) used a spindle, with a worm at one end and a pinion at the other. Curved rims, or cam-guides, feathered the floats by acting directly on catches, in the plans of Binns (1822), Pool (1829) and Winkles (1840). Parr (1825) caused the pressure of the water to feather the float on an axis dividing it unequally; Binns (1822) loaded the float so as to keep one edge always lowermost. This mode was repeatedly patented.‡ Skene (1827) combined these two last means, and bridle-bars were added by Vint (1835). Long before this, Lambert, in 1819, kept the free edges of the floats lowermost by attaching them all to a heavy circular rim without bearings.§ Parlour (1838) feathered the floats by a divided shaft, of which the part attached to the float spindles turned twice for each revolution of the other part.

In 1813, Robertson Buchanan patented his invention for feathering each float by a spoke from an arm on its spindle, jointed to a rim turning on a fixed eccentric.

This application of the eccentric was repeatedly patented, in various shapes, and many of the plans are so similar, if not identical, that it is evident their inventors were ignorant of what had been done before. It is to be regretted that, in many of these cases, from £300 to £500, besides often ingenuity, time, energy, and private expenditure, were thus needlessly thrown away; and it is to be hoped that, by the enlightened policy of the present authorities at the Patent Office, inventive energy will be delivered from a useless repetition of past efforts, and genius will be set free to cultivate new fields of labour.

* Some of these variations of form will be found in the following patents:—Perkins, 1829; Gemmell, Cave, and Hall, 1837; Rennie, 1839; Rapson, 1840; Joest, 1841; Biram, Lander, 1842; Smart, 1843; Handcock, 1844; Cartwright, Blyth, and Parlour, 1845; Barlow, 1851; Flynn, 1852; Scott, 1854; Bellford, 1855; Chatterton, 1855; Parkhurst, 1856; Crooker, 1857.

† Massie (1836), dividing each float into parts with parallel bars, caused one set to move over the other for reefing. For attaching the floats Hamond (1844) used wedges, while screws were employed by Brown (1847).

‡ Mercey (1825) tried to make the float feather by buoyancy, and Hill (1825) connected all the floats together by forked jointed pieces.

§ Cochran patented this ten years afterwards, and Napier did the same in 1841; Miller (1848) added small guide rollers to steady the rim and increase the vertical pressure.

In 1827, Oldham put the feathering eccentric on a hollow shaft, embracing the paddle-shaft, and so turned slowly, by fixed cog-wheels, as to cause the side edges of each float to point to the top of the wheel.

Bernhard (1828), Anderson (1828), and Giffard (1837), made the eccentric adjustable, so as to regulate the angles of exit and entrance of the floats.*

In Lagergren's plan (1855), the rim on one side was higher than that on the other, and each float revolved on horizontal bearings, placed at its diagonal points.

Pickworth (1836) made each feathering float to consist of a frame carrying louvre boards on vertical spindles.

In Bramwell's plan (1851), an eccentric motion and springs caused the arm and float to yield at the beginning of the stroke, and to work at greater angular velocity near the end. Ross (1856) gave to the outside edge of hinged floats a similar variable motion. The paddle floats of the *Leviathan* do not feather.

Among the few patents relating to paddle-boxes, we may notice Cochran's (1818), for forcing smoke from the furnace into a closed paddle-box partly submerged, so as to exclude the water. Palmer (1839) did this by pumping in air, while Taylor (1848) allowed it to be forced in by the waves. Symington (1835) led the spray from the paddle-box to cool the engine; and the well-known paddle-box boats were patented by Smith in 1838.

We must go back again to early times for the first appearance of the screw-propeller. It is probable that, as the action of a watermill suggested the use of the paddle-wheel, so the motion of a windmill may have prompted the use of the oblique vaned propeller.†

In 1729, Duquet submerged an apparatus like a smoke-jack or windmill, and the action of the stream turned its shaft so as to wind up a rope.

In 1746, Bouguer states that "revolving vanes, like those of a windmill," had been tried for the propulsion of vessels, but it is not clear that the axis was turned by force inside the vessel, or that the method was an advance on that of Duquet.

The use of the screw-propeller in China may be of an indefinite antiquity. A model of one was brought from that country about the year 1780. It had two sets of blades, turning in opposite directions; but the first distinct description of the screw-propeller to be turned by machinery inside a vessel, seems to have been by D. Bernouilli, of Groningen, in 1752, and it is remarkable that this, though the earliest recorded proposal, was well enough matured to comprise the use of oblique vanes at the bow, sides, and stern, turned by a steam-engine, and capable of being hoisted out of the water. The woodcut (next page) representing the inventions of Bernouilli, is copied from one published A.D. 1803, in *Annales des Arts et Manufactures*, Tom. 20, Pl. II., p. 100.

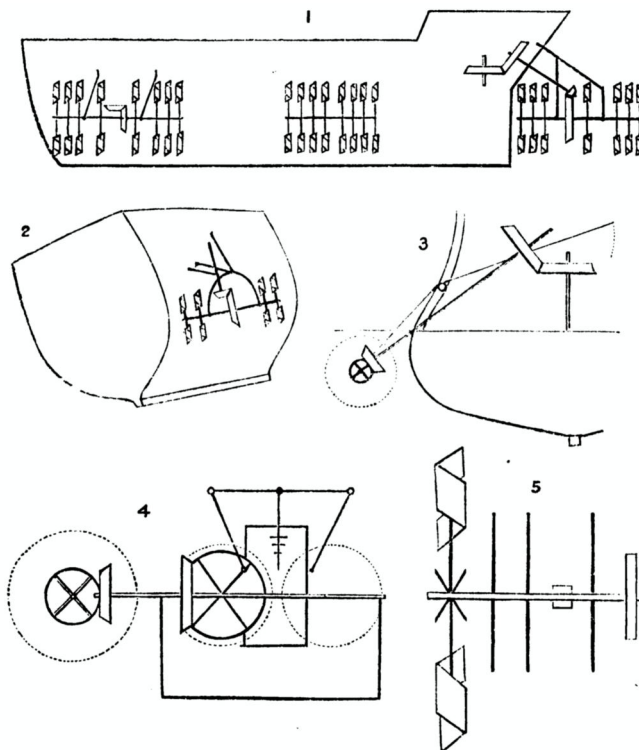
In 1768, Pauton proposed the pterophore, a screw thread on a cylinder, to be wholly or partly immersed. In 1770, James Watt suggested to Dr. Small the trial of a steam screw-propeller; Bramah, in 1785, first patented a rotary engine for this purpose; Ramsey (1792) put the screw between two hulls, and Lyttleton (1794) used a three-threaded screw, while Fulton (1798) tried one with four blades. Shorter's screw, (1800), with a jointed shaft,‡ and worked by men, was applied in 1802, to H.M. ships *Dragon* and *Superb*. The first screw steamer I can find was tried by Stevens in America§ in 1804. In 1825 Brown used one on the Thames.

* This is done by levers, or by a sector working a framework jointed to the rods that work the floats.

† The windmill is of an unknown antiquity. There is an interesting description of it by R. Hooke, in 1681. It will be observed that under the term "screw-propeller," we include every rotating propeller with oblique vanes which urges the vessel in a direction parallel to the propeller shaft.

‡ Patented again by Phipps, 1850, with a moveable outside bearing, and by many others.

§ Worked first by a rotary engine, afterwards by Watt's reciprocating engine. In this year, 1804, Boaz made experiments



1. Side view of Bernoulli's Screw Propellers at the bow, side, and stern of a vessel.
2. Three-quarters view of the side propeller.
3. Stern view of ditto, with a cross section of the vessel.
4. The steam-engine.
5. Enlarged view of the propeller.

The only patent for combining the screw-propeller and paddle-wheel is that of Turk, in 1852. The Bee, a naval steam-tender at Portsmouth has carried both paddles and screw since 1842, but they are not worked together.

Screw-propellers are so various in form that we can scarcely arrange them for consideration according to their shapes or modes of action.* It will be better to group the inventions according to the several parts of the apparatus they relate to. And first, with respect to

with the screw. The following information is extracted from the Board of Trade papers:—Total number of steam-vessels registered up to Jan. 1, 1857, 1668, of which there were wooden, with paddle-wheels, 820; with screw propellers, 19, total of wood, 839. Iron, with paddle-wheels, 356; with screw-propellers, 473; total of iron, 829. From the Navy List, we learn that there are at present, in the Royal Navy, wooden steamers with paddle wheels, 67; with screw-propeller, 160; and 185 gunboats. Iron steamers with paddle, 15; with screw, 10; with both paddle and screw, 1. Total number of war-steamers, 427, carrying about 16,000 guns, and of 86,000 horse power. In 1814, there were only 2 steam vessels belonging to the British empire. These had increased, in 1855, to 2,010, of 408,290 tons. The number of steam-vessels has doubled since 1845, and their tonnage increased threefold. The first iron steam-vessel was made in 1822. In 1856, 54 wooden and 175 iron steam-vessels were built, (tonnage 57,573) and 35 of both kinds were wrecked. Within the last 12 years, about 20 large mail packets have been lost. Since 1853, 2,000 persons have perished, and ten millions of dollars worth of property have been destroyed in the wrecks of the United States coasting mail packets.

* A general division may be made into two classes. In one (as in the plans of Bernoulli and Bouguer) no thread continues through an entire revolution. In the other a helical thread has at least one revolution (as in the the plans of Duquet and Paucton).

the general arrangement of the whole apparatus, there is scarcely any position under or above water all round the vessel which has not been proposed for the screw-propeller; indeed most of these varieties of position were exhausted by the earliest plans.

The first English patent relating to the subject is Miller's, in 1775. Here the blades are at the end of the arms of a windmill on a vessel's deck, with its axis parallel to the keel. Duncan (1851) put the blades on an endless strap, running outside over the deck and round the hull. He suggested also (1856) that a spiral rib, wound round a floating cylinder, should act for propulsion as the cylinder is caused to turn.*

Bernoulli and Shorter, having suggested propellers at the bow, sides, and stern of a vessel, Cummerow, in 1828, placed one in an opening in the stern deadwood, which is now the usual position.

Taylor, again (1838 and 1846), using two propellers on separate shafts, brought them so near that the blades overlapped and passed between each other. Napier (1841) placed one of the approximated propellers astern of the other. Carpenter (1851), put two propellers in separate stern-pieces. Bucholz (1851) had three of them, and placed the middle one astern of the others. In all these cases the shafts were on the same level, but Tombs (1856) placed the shaft of one (the aftermost overlapping propeller) a short distance above the other shaft, to which it was geared,† so as to turn in an opposite direction.

Next, we must notice different propellers on the same

* A similar mode of propulsion used by an insect is noticed near the end of this paper.

† Morrison (1854) placed one propeller "above the other."

axis. Perkins patented this plan* in 1824, placing one shaft within the other, and turning the screws in opposite directions. Church patented it in 1829, and Ericsson in 1836, when a hoop with short vanes was used instead of blades.

Such were the positions of the propeller when in use; but it was soon found needful to have a power of altering the position, so as to hoist it out of the way. For this purpose, Bernouilli (1752) put hinges on the rods supporting his side propellers, and detached the propeller from the shaft at the stern.†

In Shorter's plan (1800) the shaft had a universal joint, which allowed the propeller to be raised; Pumphrey (1829) detached the propeller at this joint; Taylor (1838) disconnected the shaft by drawing inwards the engine part, so that the propeller could be raised in vertical guides; Maudslay (1846) used a similar plan, and screwed one part of the shaft into the other, to connect them again; Galloway (1843) and Griffiths (1853) disconnected the whole apparatus by chains, which extricated the shaft from the bearings successively; Seaward (1846) lifted the propeller by rods which were screwed into the boss.‡ The propeller was raised in a different manner by Perkins (1845) and Tucker (1850), who put it on an arm turning vertically round a horizontal pin above the shaft.

Some other inventions relating to the propeller shaft may be briefly noticed. Thus Buchanan (1846) supported the shafts on springs. Montgomery (1846) and Hunt (1854) made it yield to a twisting strain. Wimshurst (1850) and Prideaux (1853) inserted a dynamometer between its parts. Blaxland (1840) put the shaft on a single spherical bearing, so that its inner end could be raised.

Various plans were suggested for receiving the horizontal thrust of the shaft. Hays (1844), Buchanan (1846), and Prideaux (1853), received the end of the shaft in a water-box; Penn (1845) upon a steel plate, revolving so as to present new surfaces to the point; Beale (1848) deflected part of the thrust along other transverse shafts by bevelled wheels. A common groove and furrow bearing is used in the *Leviathan*. Penn (1854) put wood to work on metal for the bearings under water; Buchanan (1854) placed two shafts one above the other, and the propeller could be attached to either as the vessel was loaded; Napier (1856) worked the propeller shaft at different elevations by an adjusting vertical shaft and cog wheels; James (1857) pumped water through it to be discharged at the ends of the blades, and thus to turn them.

To regulate the speed of the shaft, Galloway (1843) had a multiplying gear of bands and wheels. Maudslay (1843) used drums and an endless rope. Hays (1844) inserted an additional shaft and cogwheels, while Griffiths (1849) applied the sun and planet motion. Robertson (1856) used grooved friction wheels, and Struthers (1856) geared one shaft to the other by a cog wheel with internal teeth. Bodmer (1844) caused the propeller to turn with a velocity, alternately increasing and decreasing. Hunt (1854) connected the shaft with the throttle-valve, so that the steam was regulated by the degree of pitch of the blades; Roberts (1851) made the boss much larger than usual; and Griffiths (1849) tapered its after end to a conoidal point, and other forms

* The Chinese propeller seen by Col. Beaufoy, in 1780, had two screws turned in opposite directions, but they may have had separate axes. The plan of Perkins was patented afterwards by Smith (1838). Dugdale (1849) put several propellers on the same shaft.

† Others left the propeller free to revolve as the vessel sailed. Slaughter (1849) helped it to do so without resistance by a "donkey engine."

‡ Wimshurst (1850) used a similar plan, and disconnected the parts by withdrawing bolts; Wilson (1852) caused the propeller to be hoisted by screwing itself along the inclined shaft; Oxley (1845) enclosed the space occupied by the propeller (when at rest vertically) with water-tight doors, in a chamber kept dry by compressed air.

of the boss were applied in connection with moveable blades.

The forms proposed for propeller blades, both for outline and section, are innumerable. It is hoped that in noticing only a few, no injustice will be done to the other twists and curves and fanciful forms, so many of which remain unknown to fame.*

We shall direct our attention first to blades not moveable on the shaft. In 1825, Marestier had a screw of a "helicoidal surface." Woodcroft (1832) patented a propeller with an increasing pitch,† Smith (1836) used two threads of a half turn each at the ends of a diameter.

In the plans of Lowe (1838) and Borrie (1843) each blade revolves in a different plane. Haddan (1839) fixed two spirals at a distance from the shaft; Poole (1848) patented the "Bommereng" propeller, in which a bent blade turns about its centre of gravity in the shaft; Joest (1841) shortened every alternate blade; Dundonald (1843) bent them towards the stern; Griffiths (1849) towards the bow, or alternately each way.

Samuda (1843) put the blades projecting inwards from a hollow drum. The surface they presented was made elastic in the plans of Duncan (1816), Macintosh (1847), Hendryckx (1850), and Hunt (1854). Oxley (1845) made it expandible by wedge pieces. Amongst other forms were Sunderland's (1843), and Southworth's (1846), bounded by areas of circles; Griffiths' (1849) open in the centre, or with blades like lancets,‡ and Lowe's (1852) with an indescribable twist.

The blades were made moveable on their radial axes in the boss by Millington, in 1816.

Woodcroft (1844) effected the adjustment by a rod lying along the shaft, jointed at one end to a short arm on the blade, and carrying at the other end a stud, which takes into a groove in a short box or hollow piece, traversing the shaft on feathers.§

Woodcroft, in 1851, used another form of boss, by which the blades could be so turned on their axes, while the shaft revolved, as to operate on the water with their reversed sides, and thus to back the vessel without stopping the engines.

Hays (1844) altered the blade's angular position by screwing up a ring. Bodmer (1844) placed one pair of blades loose on the shaft, so as to be properly set as they revolved, and to rest vertically behind the false stern-post. For the like purpose Malo (1850) put the pairs of blades on different shafts, one being hollow.

Buchanan (1846) made the water turn the blade on its radial axis, and fixed it by clutches.||

Wingate (1857) turned the blade by a key, and fixed it by the friction of its conical shank in the boss.

In 1849, Griffiths caused the pitch of the blades to be altered by levers, according to the speed of the shaft. Burch (1852) substituted a large plate for the boss, and the blades thus projected beyond the ordinary hull lines

* The propeller blades of the *Leviathan* are fixed, and of a common form.

† A right angled triangle, wound upon a cylinder, traces a screw by its hypotenuse. When a spiral curve is put instead of the hypotenuse the screw will have an increasing pitch. Fraissinet (1838) used a parabolic curve, and Rennie (1839) applied another curve. Beadon (1845) and Templeton (1846) made the blades of a volute form—Rosenberg (1845) reversed the usual curvature, by making the blade near the boss parallel to the shaft.

‡ Griffiths (1849) proposed to determine the best form of curved blade by using balls floating in the wake of the propeller, so as to indicate the forces acting at different points by spring balances.

§ A full-sized model of this plan is placed in the Patent Museum, at Kensington. In 1851, the same patentee used a hollow shaft with a cog wheel acting on a pinion on each blade. The plans of Hays (1845) and Brown (1847) were nearly similar.

|| Griffiths (1853) adjusted the blades from the deck by a key working a bolt in the boss.

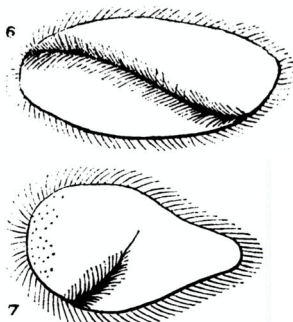
of the stern, which were continued aft beyond the propeller. Paterson (1857) produced a similar effect by using for the boss a large conical drum, coinciding at the foremost end with the shape of the vessel, which was terminated by a round vertical plane.

The screw-propeller was caused to steer the vessel by altering the direction of the shaft or the angular position of the blades. Shorter (1800) and Millington (1816) used the first plan, turning the shaft to one side or another by a Hooke's joint. Pumphrey (1829), Buchanan (1853), and Abadie (1854), attached the shafts to a frame moveable laterally with the rudder; and Bucholz (1851) geared each of his three propellers in a ring, which allowed the axis to be directed for steering.

The second mode of steering was adopted by Woodcroft (1851), who attached each blade by an arm to a rod with a stud in the groove of a box on the shaft inside the vessel. The direction of the groove could be so altered by switches as to cause the blade to act with its broadside during one part of each revolution, and thus to impel the stern to one side or another. When the blades were stationary, in a vertical position, they might be turned on their axes, so as to act like an ordinary rudder.

Foulevton (1844) and Wimshurst (1850) placed a screw on an axis athwart the vessel, so as to steer by revolving in one or the other direction.

In the modes of propulsion adopted by aquatic animals may be found almost every plan which has been used by man with machinery. Thus water is ejected for propulsion by the cuttle fish and "paper nautilus;" sails are used by the veleva and water birds; punting and towing by whelks and the lepidosiren; a folding paddle by the lobster, feathering paddles by ducks, and oblique surfaces by fish of all kinds. A screw-like appendage is found in the wings of an Australian fly, but it is supposed to be shaped thus only when dried after death. There is, however, one remarkable animal which propels itself by a rotary movement, acting on the water by means very similar to those of the paddle-wheel and screw-propeller combined. This is the infusorial insect *Paramecium*. My attention was called to this miniature Leviathan by Mr. Robert Mallet, and after some months of intellectual search, I was fortunate enough to see its operations distinctly in one of Mr. Tomkins' splendid microscopes. The form is represented in the accompanying woodcut. A sulcus or furrowed groove



6. *Paramecium Caudatum*. (Ehrenberg, Taf. 39, and pp. 351, 353.)
7. *Paramecium Compressum*.

runs obliquely round the oval-shaped body of the animal (in one variety it is only near the stern). A wave-like protuberance passing along this sulcus (with or without cilia) causes the body to rotate on its longer axis, and thus propels it as by the fore-and-aft stroke of a paddle, as well as by the screw-like progress induced by the spiral groove.

The coloured diagrams around us show, without verbal explanation, the gradual progress of marine propulsion from the early days of Nineveh, Babylon, and Egypt. We have traced its more particular application

in the rotatory action of the paddle-wheel and screw, and have seen these combined in one of nature's smallest works. Let us hope that the giant vessel now afloat will be a great success, bearing forth our sturdy emigrants to lands of plenty—honest English hearts to shores of commerce—strong hands to works of industry—strong minds to stores of knowledge—brave armies to fields of glory—and the gospel of peace to the ends of the earth.

DISCUSSION.

The CHAIRMAN said he was sure they had listened with pleasure and profit to the admirable paper of Mr. MacGregor, which could not fail to be useful in assisting inventors to avoid wasting their energies in inventing over again that which they would probably find had been invented before. He feared it was not generally believed that the faculty of mechanical invention was not a very unusual faculty—that it belonged to nearly everybody, and that it was one of the greatest misfortunes that could fall upon a man when he took it into his head that he was endowed with a larger portion of that faculty than anybody else. He could assure them that that was the thing which practical engineers were most afraid of in themselves. They had to be constantly guarding themselves against the temptation to invent, for it was a much safer course to be contented with exercising their judgment on the inventions of others. Invention, then, in mechanics, he did not think at all a distinguishing faculty; and he believed there were men in this country who could invent anything they were asked for, and all we had to do was to pay them for inventing. Therefore, he advised most people not to invent, but to pay other people, who had nothing else to do, to invent for them; they would find it much cheaper. Of the hundreds of inventions that had passed through Mr. MacGregor's hands in the extensive research he had had undertaken in preparing this paper, were they not amazed to see how few were at this day in practice; and were they not struck with the fact that nearly all the inventions they now heard of no more seemed monstrously ingenious, whilst the inventions actually in use were those which appeared to have got rid of all the ingenuity, and to have merely retained one or two plain, simple, common sense elements in them. Now, that was the lesson which he would wish Mr. MacGregor's paper to have taught to that audience, especially the younger members, and that was the lesson he hoped it would teach to the mechanical world at large in the wider sphere of its influence when published in the *Journal of the Society*. There was another very good rule which might be laid down, and that was that no man should set about inventing anything but what had reference to his own trade. He remembered a person coming to him and saying, "I wish you would find a situation for my brother on a railway or steam-boat, or anything else that you are connected with." He asked him what his brother was, and he replied that he was a portrait painter, while he himself was a house painter; and he (Mr. Russell), then asked him why he thought his brother would be more useful in one of the occupations he had mentioned, rather than in assisting him in house painting, which he (Mr. Russell) thought was more closely allied to portrait painting. He, therefore, humbly suggested this to him, as being better and more appropriate than an employment either on a railway or a steam-boat; to which his Scotch applicant replied, that his brother might do very well for a railway, or a steam-boat, or anything else, but he would never make a house painter. He continually had gentlemen coming to him and inventing for him something to assist him in his business, of which they began by telling him they knew absolutely nothing, and when, in return, he ventured to suggest the propriety of devoting a little of their spare time, which they devoted to his trade, to the making of better shoes or coats,

which might be their own business, he was sorry to say he was treated with the greatest disdain for presuming to give advice in a matter of which, of course, he knew nothing whatever. He had now to ask gentlemen whom he saw present to give them any additional facts on this subject that they might be acquainted with, and he would merely set the example by stating that, previously to the year 1830, he saw a steam-boat propelled by the screw, and it reached a speed of from 5 to 6 miles an hour. The results were communicated to the Admiralty, prior to 1830, by the late Mr. Adams, of Edinburgh, and there was a commission appointed to investigate the subject, who reported upon it unfavourably. With reference to Mr. MacGregor's researches, he thought the public was very much indebted not only to him, but also to Mr. Bennett Woodcroft, of the Patent Commission, who had, for the first time, made the vast stores of ingenuity deposited in the Patent-office accessible to the public at large, and who had also formed the nucleus of a Museum of Inventions, which he had no doubt, within the next five-and-twenty years, would be one of the most remarkable and interesting institutions in the British empire. That museum was now partly collected in the Patent-office in Chancery-lane, and partly at the Kensington Museum. The Society of Arts had endeavoured to assist in obtaining some large public building to be set apart for collections of models and records of inventions, in order that inventors might at a glance see all that their predecessors had done. He thought, perhaps, Mr. MacGregor was not aware that a propeller had been introduced by Mr. Rennie, in which he used a diamond-shaped or triangular float instead of a parallelogram, and some advantages were said to result from this arrangement.

Mr. GEORGE RENNIE said, although he did not class himself amongst those unfortunate inventors who had thrown away their time in useless inventions, yet he could not but confess that he had been somewhat of a dabbler in invention. His first notions of screw propulsion were not come to by chance, but were arrived at after mature consideration of the question. While he was trying experiments on the resistance of water, he found that on revolving two square boards through the water, at the extremities of radii, they presented a certain resistance, which was as the squares of their velocities. It was clear that the outer portion of these floats moved with a greater velocity than the inner portion, and that consequently there must be a point between these two which would represent the centre of resistance. He reasoned upon that, and the conclusion he came to was, that he would obtain an advantage by taking off a portion of the inside of the float. He therefore took off two corners of the square, and caused it to revolve in the water, and he found the resistance to be as great as before. He ultimately arrived at a form much resembling the duck's foot—a triangle; thus following one of the most perfect adaptations of nature. The same principle was seen in the formation of the wings of birds and the tails of fishes, and it was found that the more acute the tails of the fishes and the wings of birds were, the faster they moved. Mr. Rennie added that he had had the satisfaction of seeing his discoveries taken up by no less a person than Mr. Ewbank, of New York, who made a series of experiments with the various forms of floats, and found that the triangular floats, in whatever position they were placed, exercised the greatest power in propulsion. His next attempts were directed to the screw propeller, and it occurred to him that the object of the screw was not merely to drive the vessel through the water, but that it should also be of such a form as to pass the water easily. Mr. Rennie concluded with a description of a screw propeller which had been designed by himself, called the "Conoidal Propeller."

Mr. GRANTHAM felt great pleasure in responding to the invitation of the Chairman, although he feared the little he could say upon the subject would not be of any

great interest to those present. It was true he was early engaged in the investigation of this subject. He was much interested by and fully concurred in the very excellent advice which the Chairman had given to the class of people who looked upon themselves as inventors. It so happened that he (Mr. Grantham) occupied a position in Liverpool similar to that of the Chairman and other gentlemen in London, and he was frequently called upon to give similar advice. Inventors often came to him with some adaptation as they called it, of the laws of nature applied to mechanics—the fish's tail, the duck's foot, or something of that sort, and they argued that their plan which was an imitation of one of those organic structures must be a good one because it was the plan which the Almighty had adopted in forming those creatures and in adapting their organisation to the sphere of existence in which they were placed. He thought this question was simply set at rest by the reflection that if the fish's tail was the best propeller, why had the Almighty formed the duck's foot to be used for this purpose? and if the duck's foot was the best propeller because it constituted a feathering float, why had the Almighty also formed the tail and the fins of the fish to answer the purpose of propellers? He had no intention to treat this subject lightly, but he said this in order to check the propensity which so many persons had to run wild on those matters. He had been very much interested by the paper of Mr. MacGregor, but there were one or two points in it in which he thought the inquiry might be extended a little further. With reference to the paddle-wheel, Mr. MacGregor was, perhaps, not acquainted with an American invention that had been applied to one or two large vessels, but as it came so soon before the introduction of the screw it succumbed to that, which was now generally held to be the best method of propulsion. This plan consisted of submerged paddle-wheels, which corresponded, in some measure, with Galloway's invention of the water-tight paddle-box. There were two small wheels on the sides of the ship completely submerged. The paddle-boxes were water-tight in all parts except at the bottom. The wheel itself was formed of a closed drum or cylinder, with floats on the outer periphery. The wheels were set in motion by a shaft going through the ship's sides, and being made to revolve at a moderate speed, it was found that the centrifugal force at the periphery of the wheel was sufficient to exclude all the water from the inner part of the paddle-box, so that the whole effort was in the right direction for driving the ship—at the bottom part of the floats. With reference to the screw, his attention was, at first, more particularly directed to the means of driving the screw rather than to the form of the screw itself, and this was a very important element in screw propulsion. In 1843 he read a paper before the Institution of Civil Engineers, descriptive of a small vessel, called the Liverpool screw, which had been built, he believed, in the previous year, and in which, for the first time, the screw was driven in a simple manner direct from the engines. Many interesting experiments were made with that vessel. It was the subject of several evenings' discussion before the Institution, and it would surprise them to hear that at that time there was scarcely one out of the whole number of eminent engineers there assembled, who thought it feasible to drive a screw direct from the engines. That was in 1843. Of course they were all aware now that the prevalent mode of driving the screw was direct from the engines, as it was not only found to be perfectly feasible, but also, he believed, the simplest and best plan. The results of the experiments with that vessel were extremely interesting, although they were not much noticed at the time. He might mention that the same vessel was still at work, and having been lately through his hands was found to be in excellent order. There was one interesting feature which he mentioned at the time his paper was read, which he had not seen noticed in any of the experiments with the screw-propeller. The

trial was made in the Mersey in fine weather and smooth water. The vessel was first driven at full speed a-head, and then stopped suddenly and the engines reversed. It was then found that the vessel, as is usual in screw propulsion, swung round several points, until she begun to make stern way, when she immediately began to steer as before and kept on perfectly straight. It was then a prevalent idea that the lateral motion of the screw would act very much against the steering of the ship, and that a loss of power, and, consequently, of speed would result. As the vessel was very light, by trimming her with some pig iron, at least one-third of the screw was raised out of the water, and when it was in that condition he again tried experiments as to the steering qualities of the ship. The result was that when she was under way he could, with one finger on the spoke of the wheel, easily steer her in any direction, showing how very little oblique action there was in a well-made screw, when the vessel was in motion; and this was also shown in the before-mentioned experiment of reversing, which proved that while the vessel was going in an opposite direction to the screw there was an immense lateral action, which caused the vessel to swing round, but when the vessel moved in the same direction as the screw the effect was altered. This went to show that the lateral action ceased to a great extent when the ship was going with the screw, and that the fears as to the loss of power in the screw were to a great extent groundless.

Mr. CHARLES ATHERTON thought they must all be struck with the remarkable manner in which Mr. MacGregor had verified the old proverb, "There is nothing new under the sun." The only point on which he would offer any observations was, that although in times past there had been such an immensity of invention yet it had lain dormant, and it seemed to be the province of the present age to utilise those inventions which for so long a time remained unknown. It was remarkable that amidst the numerous kinds of screw which had been invented, it was impossible for any one at the present day to say which was the best. In the position which he occupied, a great many different plans of screws naturally came under his notice, and he might have had particular fancies with regard to some of them; but generally speaking mere individual opinions were wrong, inasmuch as some essential point of an invention was often overlooked. He might instance the screw introduced by Griffiths. When that was first introduced, the general opinion was, that width at the end of the screw was desirable in order to gain power; but in Griffith's screw the fan was nearly the shape of a heart. Although that was the reverse of what they had supposed to be a necessary condition of a screw, still he was not prepared to say that it was inferior to any other form of screw; and he even believed it was in a position to compete successfully with any other. He did not appear as the advocate of any particular screw, but he contended that practical experience alone must decide the question of superiority. When they came to the practical part of the question, he thought it was very desirable that engineers should fix some standard by which to judge as to what should be regarded as a really reliable experiment, so that they should be able to discern between a good result and a bad one, which certainly was not the case in the so-called trial trips of the present day. He also thought it very desirable that proprietors and agents of screw steam vessels should furnish engineers with the statistics that they had in their possession, and which were necessary to the investigation of these points. By so doing they would not only promote the advancement of science, but at the same time further their own private interests.

The CHAIRMAN said it was now his duty to propose that they should return their warmest thanks to Mr. MacGregor for his admirable paper, which was so well calculated to promote the advancement of manufactures

and mechanical invention, and to thank him also for the very valuable services which his laborious researches on this subject, and his judicious elucidation of the relation of these inventions to one another had conferred upon mechanics in general, and especially upon those younger men who were growing up as mechanics, to whom we must look for the carrying out of inventions in the next generation as successfully, and, he hoped, still more successfully, than they were carried on in the present generation.

The Earl of CAITHNESS had great pleasure in seconding the motion. When they considered how much ingenuity had been bestowed on such a variety of screws and floats, it was almost surprising to find that any attention was paid to the accommodation of passengers and merchandise. But so admirable were the arrangements of the present system of marine propulsion, that not only was ample accommodation afforded for passengers, but very large space was secured for merchandise, whilst a speed had been attained on the ocean which a few years ago was thought to be impossible. He recollected when Mr. Taylor first proposed to Mr. Miller, of Dalswinton, to put an engine into a boat, the idea was laughed at, but after consideration Mr. Miller yielded to the request, and the engine was furnished by Symington. The vessel was tried, and the beautiful picture of Dalswinton on the table was evidence, if any were wanted, that such a thing took place. The steam-engine, as applied to vessels, had gone on progressing from year to year until we were not contented with the small vessels afloat, but had now to contemplate its application to the immense ship which had been built by his friend Mr. Scott Russell; and he was sure that all present most earnestly hoped that she would turn out a success, and would prove to be the finest vessel afloat. The magnitude of this vessel was such, that although her commander and many naval officers, as well as her projectors, entertained not the slightest doubt of her success, yet, as a hitherto untried experiment upon so grand a scale, the result would be looked to with the deepest interest by all. It was easy for the Chairman to recommend people not to invent, but the difficulty was for any one to keep himself from inventing. They might almost as well tell people not to think, as tell them not to invent. At the same time he considered that Mr. Scott Russell had given them all very excellent advice, and he (Lord Caithness) would join in the advice given—that before they began to invent they should ascertain whether the same thing had not been invented before. He could speak from his own knowledge and experience that when he thought he had conceived some grand idea, he often found it had been given birth to many years before. He thought they were not only obliged to Mr. MacGregor for his admirable paper, but they were also indebted to Mr. Scott Russell for his wholesome advice and his conduct in the chair.

A vote of thanks was then passed to Mr. MacGregor.

The Paper was illustrated by a very large number of sketches and diagrams, made by Mr. MacGregor, as well as by numerous models, kindly lent from the Museum of the Commissioners of Patents.

At the conclusion of the discussion, Mr. C. Wentworth Dilke, Chairman of the Council, announced the decision of the Council in reference to the intended Exhibition of Industry and Art in 1861, and read the resolutions given on the first page of the present number of the *Journal*.

The Secretary announced that on Wednesday evening next, the 21st inst., a Paper by Mr. C. W. Siemens, "On the Progress of the

Electric Telegraph," would be read. On this evening, Mr. W. R. Grove, Q.C., F.R.S., will preside.

MIDDLE CLASS EXAMINATIONS.

The University of Cambridge have issued the following Regulations for the year 1858 concerning the Examination of Students who are not members of the University:—

There will be two Examinations, commencing on Tuesday, December 14, 1858; one for students who are under 16 years of age, and the other for students who are under 18 years of age.

Students will be examined in such places as the Syndics, appointed by the University, may determine.

After each Examination the names of the students who pass with credit will be placed alphabetically in three honor classes, and the names of those who pass to the satisfaction of the Examiners, yet not so as to deserve honors, will be placed alphabetically in a fourth class. After the name of every student will be added his place of residence, and the school (if any) from which he comes to attend the Examination.

In determining the classes, account will be taken of every part of the Examination; but no credit will be given for knowledge in any subject, unless the student shows enough to satisfy the Examiners in that subject. Regard will be paid to the hand-writing and spelling throughout the Examinations.

The students who pass with credit, or satisfy the Examiners, will also be entitled to receive certificates to that effect. Every certificate will specify the subjects in which the student has passed with credit, or satisfied the Examiners, and the class in which his name is placed.

Every one admitted to Examination will be required to pay a fee of twenty shillings.

EXAMINATION OF STUDENTS WHO ARE UNDER SIXTEEN YEARS OF AGE.

Students must be under 16 years of age on the day when the Examination begins.

PART I.—PRELIMINARY.

Every student will be required to satisfy the Examiners in

1. Reading aloud a passage from some standard English prose author.
2. Writing from dictation.
3. The analysis and parsing of a passage from some standard English author.
4. The first four rules of Arithmetic, simple and compound, Vulgar Fractions, Practice, and the Rule of Three.
5. Geography:—Every student will be required to answer questions on the subject, and to draw from memory an outline map showing the coast line, the chief ranges of mountains, and the chief rivers of one of the countries in the following list:—England, Scotland, Ireland, Europe, Asia, Africa, North America, South America, Australasia.
6. The outlines of English History since the Conquest; that is, the succession of Sovereigns, the chief events, and some account of the leading men in each reign.

PART II.

The Examination will comprise the subjects mentioned in the following ten sections: and every student will be required to satisfy the Examiners in three of those sections at least, but no one will be examined in more than six. Section I. must be one of the three, unless the parents or guardians of the student object to his examination in that section.

1. Religious knowledge: Questions will be set on—

(a) The two Books of Samuel, the Gospel of St. Matthew, and the Acts of the Apostles:

(b) The Church Catechism:

(c) Whateley's "Easy Lessons on Christian Evidences."

Every student, who is examined in this section, will be required to satisfy the Examiners in the subject marked (a), and in one at least of the subjects marked (b) and (c).

2. English:—Every student, who is examined in this section, will be required to write an original English composition. He will also be examined in English History, from the battle of Bosworth field to the Restoration: Physical, Political, and Commercial Geography: Trench, "On the Study of Words."

3. Latin:—Passages will be given from Sallust's "Bellum Catilinarium" and Virgil's "Æneid," Book VI. for translation into English, with questions on the parsing and the historical and geographical allusions: Also an easy passage for translation from some other Latin author: And a passage of English, with Latin words supplied, for translation into Latin.

4. Greek:—Passages will be given from Xenophon's "Anabasis," Book II., and Homer's "Iliad," Book VI., for translation into English, with questions on the parsing and the historical and geographical allusions: Also an easy passage for translation from some other Greek author.

5. French:—Passages will be given from Voltaire's "Charles XII.," for translation into English, with questions on the parsing and the historical and geographical allusions: Also a passage from some modern French author for translation into English: And easy English sentences for translation into French.

6. German:—Passages will be given from Lessing's "Fables," prose and verse, for translation into English, with questions on the parsing: Also a passage from some modern German author for translation into English: And easy English sentences for translation into German.

7. Pure Mathematics:—Every student, who is examined in this section, will be required to satisfy the Examiners in Euclid, Books 1 and 2, Arithmetic, and Algebra to simple Equations inclusive. Credit will be given for a knowledge of Book-keeping. Questions will also be set in Euclid, Books 3, 4, and 6, in Quadratic Equations, Progressions, Proportion, Plane Trigonometry not beyond the solution of Triangles, the use of Logarithms and Mensuration.

8. The elementary principles of Mechanics and Hydrostatics:—Questions will be set, embracing the proofs of the leading Propositions. In Mechanics they will not extend beyond the parallelogram of forces, the centre of gravity, and the mechanical powers. In Hydrostatics they will not extend beyond the transmission of fluid pressure, the equilibrium of inelastic fluids and of floating bodies, and the description of the steam engine and of simple hydraulic machines. A fair knowledge of Mechanics will enable a student to pass in this section.

9. Chemistry:—Questions will be set on the elementary facts of Chemistry, and the laws of chemical combination. Solutions will be given to be tested, containing not more than one acid and one base.

10. Zoology and Botany:—Elementary questions will be set on the description and classification of animals, their habits and geographical distribution; and on the mercantile and industrial uses of animal products: Also on the description and classification of Plants, their uses and geographical distribution: British plants and parts of plants will be given for description.

PART III.

Students may also offer themselves for Examination in

1. Geometrical and Mechanical Drawing.
2. Drawing from the Flat, from Models, from Memory, and in Perspective.
3. The Grammar of Music.

EXAMINATION OF STUDENTS WHO ARE UNDER EIGHTEEN YEARS OF AGE.

Students must be under eighteen years of age on the day when the Examination begins.

PART I.—PRELIMINARY.

Every student will be required to satisfy the Examiners in

1. Reading aloud a passage from some standard English poet.
2. Writing from dictation.
3. Analysis of English sentences and parsing.
4. Writing a short English composition.
5. The principles and practice of Arithmetic.
6. Geography.

Every student will be required to answer questions on the subject, and to draw from memory an outline map of some country in Europe, showing the boundary lines, the chief ranges of mountains, the chief rivers, and the chief towns.

7. The outlines of English History; that is, the succession of Sovereigns, and chief events, and some account of the leading men in each reign.

PART II.

The Examination will comprise the subjects mentioned in the following eight sections; and every student will be required to satisfy the Examiners in three at least of the sections marked A, B, C, D, E, F; or in two of them, and in one of the sections marked G, H; but no one will be examined in more than five. Section A must be taken by every student, unless his parents or guardians object to his examination in that section.

SECTION A.

Religious Knowledge: The Examination will consist of questions in

1. The Historical Scriptures of the Old Testament to the death of Solomon. The Gospel of St. Luke and the Acts of the Apostles. Credit will be given for a knowledge of the original Greek.

The Morning and Evening Services in the Book of Common Prayer, and the Apostles' Creed.

3. Paley's "Horæ Pauline."

Every student who is examined in this section will be required to satisfy the Examiners in the subject marked 1, and in one at least of the subjects marked 2 and 3.

SECTION B.

1. English History, from the battle of Bosworth-field to the Restoration; and the outlines of English Literature during the same period.

2. Shakspeare's "Julius Cæsar (Craik's edition).

3. The outlines of Political Economy and English Law:

The Examination will not extend beyond subjects treated of in the first book of Smith's "Wealth of Nations" and the first volume of Blackstone's "Commentaries.

4. Physical, Political, and Commercial Geography.

A fair knowledge of one of these four divisions will enable a student to pass in this section.

SECTION C.

1. Latin: Passages will be given from Livy, Book xxi., and Horace, "Odes," Book iii., for translation into English, with questions on the historical and geographical allusions, and on Grammar: Also passages for translation from some other Latin authors: and a passage of English for translation into Latin.

2. Greek: Passages will be given from the "Olynthiacs" of Demosthenes and the "Alcestis" of Euripides, for translation into English, with questions on the historical and geographical allusions, and on grammar. Also passages for translation from some other Greek authors.

3. French: Passages will be given from La Bruyère's "Characters," and Molière's "Misanthrope," for trans-

lation into English, with questions on grammar. Also passages from some other French authors for translation into English; and a passage of English for translation into French.

4. German: Passages will be given from Schiller's "History of the Revolt of the Netherlands, and Goethe's "Hermann and Dorothea," for translation into English, with questions on the historical and geographical allusions, and on grammar. Also passages from some other German authors for translation into English; and a passage of English for translation into German.

A fair knowledge of one of these four languages will enable a student to pass this section.

SECTION D.

Every student, who is examined in this section, will be required to satisfy the Examiners in Euclid, Books i., ii., iii., iv., v., and xi. to Prop. 21, inclusive. Arithmetic and Algebra.

Questions will also be set in the following subjects:—

Plane Trigonometry, including Land-surveying.

The simpler properties of the Conic Sections.

The elementary parts of Statics, including the equilibrium of forces acting in one plane, the laws of friction, the conditions of stable and unstable equilibrium, and the principle of virtual velocities.

The elementary parts of Dynamics, namely, the doctrines of uniform and uniformly accelerated motion, of projectiles and collision.

The elements of Mechanism.

The elementary parts of Hydrostatics, namely, the pressure of elastic and inelastic fluids, specific gravities, floating bodies, and the construction and use of the more simple instruments and machines.

The elementary parts of Optics, namely, the laws of reflection and refraction of rays at plane and spherical surfaces (not including aberrations), lenses, the phenomena of vision, the eye, microscopes, and telescopes.

The elementary parts of Astronomy, so far as they are necessary for the explanation of the more simple phenomena, together with descriptions of the essential instruments of an observatory; and Nautical Astronomy.

SECTION E.

1. Chemistry: Questions will be set on the facts and general principles of Chemical Science. There will also be a practical Examination in the elements of analysis.

2. The experimental laws and elementary principles of Heat, Magnetism, and Electricity.

3. The elementary principles of Physical Optics according to the undulatory theory, and Acoustics, with descriptions of the fundamental experiments.

A fair knowledge of Inorganic Chemistry, or of one of the divisions 2 and 3, will enable a student to pass in this section.

SECTION F.

1. Comparative Anatomy and Animal Physiology: The Examination will be confined to the active and passive organs of locomotion.

2. Botany, and the elements of Vegetable Physiology.

3. Physical Geography and Geology: Explanations of Geological terms will be required, and simple questions set respecting stratified and unstratified rocks, the modes of their formation, and organic remains.

A fair knowledge of one of these three divisions, including a practical acquaintance with specimens, will enable a student to pass in this section.

SECTION G.

Drawing from the Flat, from Models, from Memory, and in Perspective; and Drawing of Plans, Sections, and Elevations.

Design in pen and ink, and in colour.

A fair degree of skill in free-hand drawing will be required in order that a student may pass in this section.

Questions also will be set on the history and principles of the arts of Design.

SECTION H.

The grammar of Music.

The history and principles of Musical Composition.

A knowledge of the elements of Thorough Bass will be required, in order that a student may pass in this section.

Local Committees, wishing to have Examinations held in their several districts, may obtain all necessary information from the Vice-Chancellor of the University.

Applications on behalf of Students desiring to be examined at Cambridge must be made on or before November 1, 1858.

Applications from Local Committees for examinations to be held in their districts must be made on or before October 1, and the probable number of students to be examined must be then stated. The names of such students must be sent to the Vice-Chancellor on or before November 1858, together with statements of the subjects in which they will offer themselves for examination.

The fees for all students must be paid on or before November 1, 1858.

SOUTH KENSINGTON MUSEUM.

During the week ending 10th April, 1858, the visitors have been as follows:—Morning, 9,195; Evening, 6,223. Total, 15,418.

Home Correspondence.

ALUM IN BREAD.

SIR,—Permit me to state that during the last few months I have been professionally employed to examine bread obtained from various London bakers, especially with reference to its containing alum, and that, out of some sixteen samples examined, I have in no case been able to detect the presence of more than a minute trace of alumina.

As the processes which I employed for the detection of the alum were the imperfect ones commonly in use by chemists—Kuhlmann's, for example—no doubt even the minute traces of precipitate which I obtained, and which are generally supposed to be alumina, really consisted partly, if not entirely, of phosphate of lime and phosphate of magnesia. I should certainly have determined this point definitively, by submitting the precipitates to analysis, had I obtained them in sufficient quantity.—I am, &c.

RICHARD V. TUSON, F.C.S.

Oxford-court, Cannon-street, E.C., April 15th, 1858.

MEETINGS FOR THE ENSUING WEEK.

- MON. United Service Inst., 8j. Capt. Fishbourne, "On Floating Batteries."
 TUES. Royal Inst., 3. Mr. J. P. Lacaita, "On the History of Italy during the Middle Ages."
 Syro-Egyptian, 7j. Anniversary.
 Civil Engineers, 8. Discussion "On Hydraulic Mortar."
 And, if time permits, Mr. J. Brunlees, M. Inst. C.E., "Iron Viaducts over the Rivers Leven and Kent in Morecambe Bay," and Mr. R. J. Hood, M. Inst. C.E., "On Railway Stations."
 Statistical, 8. Mr. Lumley, "On the Administration of the Poor Law in the Metropolis."
 Pathological, 8.
 WED. United Service Inst., 3. Dr. Bird, "On the Principles of Military and Naval Hygiene, necessary for practically improving the Sanitary Condition of British Soldiers and Sailors at home and abroad."
 Royal Soc. Lit., 4. Anniversary.
 London Inst., 7.
 Society of Arts, 8. Mr. C. W. Siemens, "On the Progress of the Electric Telegraph."
 Microscopical, 8.
 THURS. Royal Inst., 3. Prof. Tyndall, "On Heat."
 Royal Society Club, 6.
 Numismatic, 7.
 Philological, 8.
 Royal, 8j.

- FRI. Antiquaries, 2. Anniversary.
 United Service Inst., 3. Capt. Scott, "On the Topographical Survey of a small extent of Country."
 Royal Inst., 8j. Col. H. James, "On the Geodetic Operations of the Ordnance Survey."
 SAT. Royal Inst., 3. Mr. E. Lankester, "On the Vegetable Kingdom in its relations to the life of man."
 Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[From Gazette, April 9, 1858.]

- Dated 6th Feb., 1858.
 221. T. Waraksine, Russia—Sorting corn by its weight by means of a special machine, called "a specific corn sorting machine."
 Dated 11th March, 1858.
 488. R. Roberts, Manchester—Imp. in mechanism for engraving and otherwise copying in line, paintings and other designs on flat and curved surfaces of metal, paper, and other materials.
 Dated 13th March, 1858.
 514. J. Jameson, 10, Catherine-terrace, Gateshead—Imp. in apparatus for compressing and expanding aeriform fluids.
 Dated 15th March, 1858.
 520. R. Edwards, 1, Single-street, Canal-road, Mile-end-road—Imp. in preparing and combining materials used in lighting or kindling fires.
 Dated 18th March, 1858.
 550. L. E. Fletcher, Upper Norwood—Imp. in marine engines and boilers, and their appurtenances.
 552. C. Doley, Birmingham, E. Bigland and T. H. Worrall, Smethwick—Imp. in ornamenting metals.
 554. Sir J. C. Anderson, Bart., Fermoy—Imp. in locomotive and other carriages.
 556. T. Sufield, Bermondsey—Imp. in pumps, especially adapted for ships' purposes.
 558. T. S. Sutton, Glynleiros, Neath, Glamorganshire—Imp. in miners' lamps.
 560. A. V. Newton, 66, Chancery-lane—An improved process of polishing, blueing, and annealing articles of iron and steel. (A com.)
 562. J. A. J. Redier, Paris—An improved chronometer, called "chronoscope."
 Dated 19th March, 1858.
 564. H. Brocklebank, Coventry—Imp. in chronometers, watches, and timekeepers.
 566. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Certain imp. in the production of motive power. (A com.)
 568. G. Williams and E. Rowley, West Bromwich—An imp. or imps. in piling iron.
 570. J. M. May, Lambeth-hill—Imp. in fastenings for portmonnales, travelling bags, ladies' companions, cigar, writing, and instrument cases, fusee boxes, and other like cases or receptacles. (A com.)
 572. G. F. Muniz, Frenchwells, near Birmingham—Imp. in mixing zinc with copper and other metals.
 574. J. Bramwell, Buxton, Derbyshire—Imp. in apparatus for the prevention of accidents arising from the escape of gas.
 Dated 20th March, 1858.
 576. W. Haigh, Reddish, Lancashire—Imp. in the manufacture of a certain description of paper, and in the machinery connected therewith.
 578. P. M. Parsons, Duke-street, Adelphi, and W. Dempsey, Great George-street, Westminster—Imp. in the construction of switches and crossings for railways.
 580. J. Brooks, Elton, near Bury—Imp. in drawing frames used in the manufacture of cotton and other fibrous materials.
 582. P. Browne, Liverpool—Imp. in the screw propeller, partly applicable to the raising of fluids.
 584. W. Allen, Arthur-street, Coventry-road, Birmingham—Imp. in machinery for manufacturing screws.
 586. A. V. Newton, 66, Chancery-lane—Imp. in sewing machines. (A com.)
 Dated 22nd March, 1858.
 590. R. A. Brooman, 166, Fleet-street—Imp. in apparatus for exhibiting daguerreotype, photographic, and other stereoscopic views and pictures. (A com.)
 591. E. J. Manwaring, Lee, Kent—Imp. applicable to stereoscopic apparatus.
 592. J. Thomas, Hackney—Imp. in machinery for counting, and registering or paging.
 593. C. C. Bailey, Manchester—An improved method of supplying the feed water to boilers, and in the apparatus connected therewith.
 595. J. Jukes, Dame-street, Wharf-road, City-road, Islington—Imp. in apparatus for supplying coals to stoves and fire-places.
 597. I. Holden, St. Denis, and E. Hubner, Mulhouse, France—Imp. in preparing, heckling, or combing flax, silk, wool, and other fibres.
 599. H. A. Jowett, Sawley, Derbyshire—Imp. in machinery for transmitting telegraphic communications and making signals, applicable to railways and other purposes.

Dated 23rd March, 1858.

600. H. L. Muller, Paris—Imp. in chromographic printing.
 601. C. Atherton, H.M. Dockyard, Woolwich—Imp. in furnaces, fire grates, and stoves.
 602. A. S. Stocker, 18, Wimpole-street, Cavendish-square—Imp. in the manufacture of railway axles and tubes.
 603. W. Mould, Bolton—Imp. in machinery or apparatus for preparing and spinning fibrous materials.
 604. J. Rowbottom and T. Standeven, Halifax—Imp. in washing, wringing, and mangling machines.
 605. W. E. Wiley, 34, Great Hampton-street, Birmingham—Imp. in ever-pointed pencils.
 606. C. Clifford, Inner Temple-lane—Imp. in ships' davits, and in apparatus for stowing, lowering, and securing boats.
 607. E. Coulon, Croisset, near Rouen, France—Imp. in preventing the incrustation of steam boilers. (A com.)
 609. W. S. Keith, York-street, Southwark—An improved rotary cutting machine.
 610. C. F. Quintin, Cheltenham—A kneading machine.
 611. W. Ramsell, Deptford—Imp. in furnaces and fire-places.

Dated 24th March, 1858.

612. J. C. Wilson, 11, Soley-terrace, Pentonville—An improved method for introducing elastic substances into articles of wearing apparel, and the adaptation thereof to the manufacture of certain useful garments in which elasticity is required.
 613. R. Jackson, Calder-vale, Garstang—Imp. in machinery or apparatus for spinning cotton and other fibrous substances.
 614. H. Germer, 10, Newton-road, Bayswater—Imp. in apparatus for the manufacture of gas from oils or fatty or resinous matters.
 615. C. Chevallier, M. I. Olivier, and E. Rolland, Brussels—A machine for making and applying as soles to shoes and boots, gutta percha, caoutchouc, and other analogous substances adapted for that purpose.
 616. M. A. F. Mennons, 39, Rue del'Echiquier, Paris—Certain imp. in the construction of heating apparatus. (A com.)
 619. C. N. Kottula, Liverpool—An imp. in the manufacture of neutral hand or skin soap.
 620. A. Biddell and W. Balk, Ipswich—Imp. in steam boilers.
 621. J. F. Brinjes, jun., 25, Fieldgate-street, Whitechapel, and H. J. Collins, West-hill, Wandsworth—Imp. in the manufacture and reburning of animal charcoal.
 623. J. V. Hielakker, Brussels—An improved machine for compressing coal, other fuel, and substances requiring pressure.

Dated 25th March, 1858.

625. W. S. Clark, Atlas Works, Upper Park-place, Dorset-square—Imp. in the construction of railways. (A com.)
 626. D. A. Hopkins, Paterson, U.S.—Imp. in journal boxes.
 627. W. Crook, Blackburn—Imp. in looms.
 628. J. Nuttall, Walmersley, near Bury—Imp. in looms.
 629. G. H. Ellis, New Malton, Yorkshire—Imp. in kitchen ranges.
 630. W. E. Newton, 66, Chancery-lane—Imp. in the means of and lamps for burning certain kinds of oil and hydro-carbons. (A com.)
 631. F. Haecck, 14, Place de la Reine, Brussels—Imp. in pumps for pumping beer, wine, vinegar, oils, or other liquids, containing acids or oily matters. (A com.)
 632. F. Foucou, 44, Rue Caumartin, Paris—Imp. in steam boiler and other furnaces.
 633. W. Richards, Birmingham—Imp. in breech-loading guns and fire-arms.
 635. W. Rotjohn, Stanhope-street, Hampstead-road—Certain imp. in organs.
 636. F. A. Chevallier, Paris—Imp. in photographic apparatus.

Dated 26th March, 1858.

637. R. A. Brooman, 166, Fleet-street—Imp. in weighing machines. (A com.)
 639. P. H. G. Berard, 323, Rue St. Denis, Paris—Applying concentrated collodion to the effect of superseding caoutchouc in waterproofing stuffs of all descriptions for manufacturing garments and wearing articles, and also for applying it over painted surfaces instead of varnish.
 641. J. Horton, Smethwick—An imp. or imps. in the construction of the girders used in the guile framing of gas holders.
 643. H. Doulton, Lambeth—An imp. in the manufacture of invert blocks used in constructing sewers and drains.
 645. W. E. Newton, 66, Chancery-lane—An improved machine for performing the addition of numbers, quantities, or sums of money, to be termed the "arithmometer."

Dated 27th March, 1858.

647. J. Newman and J. F. Newman, 122, Regent-street—Imp. in spectacles.
 649. E. C. Jones, Caroline-street, Bedford-square—Imp. in railway brakes.

651. B. Burrows, Leicester—Imp. in weaving webs or narrow goods, and in ornamenting elastic webs.
 653. J. Welch, Southall—Imp. in portable railways, and in the means of their application to carriages to facilitate their movements on common roads and other surfaces.
 655. W. A. Gilbee, 4, South-street, Finsbury—Imp. in treating saccharine fluids. (A com.)

Dated 29th March, 1858.

657. W. A. Gilbee, 4, South-street, Finsbury—Imp. in treating brandies and other spirituous liquids for improving their quality. (A com.)
 659. J. R. Breckon, Darlington, and R. Dixon, Crook, Durham—Imp. in the construction of coke ovens.
 661. J. F. Spencer, 1, Adelaide-place, London-bridge—Imp. in marine engines.
 663. J. Baillie, 167, Carolinen Gasse, Vienna—An improved construction of coiled spring.
 665. I. Brown, Carlisle, and J. Brown, Notting-hill—Imp. in the manufacture or production of manure.
 667. E. A. Jacquin, Rue des Lavandieres, Ste. Opportune, Paris—An imp. in preparing plates for printing. (A com.)
 669. W. Harding, Forest hill, Kent—Imp. in revolver fire-arms, and in apparatus for manufacturing projectiles.

Dated 30th March, 1858.

671. J. C. Durand, Pimlico—Imp. in the manufacture of iron.
 673. T. Silver, Philadelphia, U.S.—Pulsating valves or governors.
 675. B. Wood, Huddersfield—Imp. in machinery or apparatus for cleansing the waste of woollen or other fibrous manufactures.
 677. W. E. Newton, 66, Chancery-lane—Imp. in the manufacture of sheet iron. (A com.)

Dated 31st March, 1858.

679. F. A. Gatty, Accrington—Imp. in treating certain compounds containing the colouring matter of madder.
 681. M. B. Westhead and H. Baines, Manchester—Certain improved apparatus for coupling or connecting carriages, wagons, trucks, vans, and engines used or employed upon railways.
 683. E. H. Todé, Peckham—Imp. in apparatus for generating steam in steam boilers by means of gas.
 685. B. W. Croker, Vienna—Imp. in axle boxes to render them self lubricating.
 687. F. Edwards, Hillfields, and W. Edwards, Howard-street, Coventry—Imp. in weaving.
 689. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in articles of buoyancy, to be used either for swimming or for the saving of life from drowning. (A com.)
 691. R. Barr, Glasgow—Imp. in machinery or apparatus for making rivets, spikes, nails, and screw blanks, and similar articles in metal.

WEEKLY LIST OF PATENTS SEALED.

<i>April 9th.</i>		<i>April 13th.</i>	
2589. J. Harland.	2637. R. G. Balderston.	2612. W. Brookes.	2637. R. G. Balderston.
2598. G. F. Lombard.	2641. H. A. L. Negretti and J. W. Zambra.	2617. J. H. Simpson.	2641. H. A. L. Negretti and J. W. Zambra.
2599. A. Barlow.	2642. J. Gibbs.	2625. J. F. Swinburn.	2642. J. Gibbs.
2601. R. Porter.	2643. P. Hellmann.	2629. J. Middleton and W. Ry-lance.	2643. P. Hellmann.
2605. F. Prestage.	2646. G. Scarr and J. Pollard.	2630. T. Restell.	2646. G. Scarr and J. Pollard.
2607. G. Beard.	2651. J. Bernard.	2631. J. Parker.	2651. J. Bernard.
2609. W. Calvert.	2656. R. J. Badge.	2632. J. C. Plomley.	2656. R. J. Badge.
2671. M. Henry.	2658. J. H. Johnson.	2634. E. Wilkins.	2658. J. H. Johnson.
2677. D. Patridge.	2690. C. Reeves.		2690. C. Reeves.
2685. I. Storey and J. H. Storey.	2751. J. Craven.		2751. J. Craven.
2713. C. de Clippelle.	2762. T. S. Prideaux.		2762. T. S. Prideaux.
	2921. H. Bessemer.		2921. H. Bessemer.
	2978. J. Howard.		2978. J. Howard.
	3000. R. Hazard.		3000. R. Hazard.
	3053. S. Biggin and J. Biggin.		3053. S. Biggin and J. Biggin.
	3156. C. Reeves.		3156. C. Reeves.
	130. J. Craven, W. Hey, and C. Worsnop.		130. J. Craven, W. Hey, and C. Worsnop.
	133. J. J. Huber.		133. J. J. Huber.
	272. A. V. Newton.		272. A. V. Newton.
	288. W. Cope.		288. W. Cope.
	299. C. Monson.		299. C. Monson.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

<i>April 6th.</i>		<i>April 10th.</i>	
789. J. H. Johnson.	802. G. F. Wilson, C. A. Han-son, and J. J. Wallis.	785. S. Fielding.	802. G. F. Wilson, C. A. Han-son, and J. J. Wallis.
801. S. Holt.		819. T. Wimpenny and J. Wim-penny.	819. T. Wimpenny and J. Wim-penny.
805. J. L. Norton.		823. G. Turner.	823. G. Turner.
		835. E. H. Bentall.	835. E. H. Bentall.
<i>April 8th.</i>			
784. W. Ricketts and T. Bulley.			

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4074	April 8.	Improved Curved Tooth-Brush	W. Herring	121, St. John-street, West Smithfield.
4075	" 9.	{ Photographic Portable Dark Operating Chamber	W. W. Rouch	180, Strand.
4076	" 9.	A Marine Course and Distance Indicator	H. Bridson	Bolton-le-Moors, Lancashire.
4077	" 12.	A Combined Needle Case	C. C. Pole	Temple, London.
			A. Turley	New-street, Worcester.